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Geology of Scott county, Iowa, and Rock
Island county, Illinois.

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GEOLOGY
OF
SCOTT COUNTY, IOWA,
AND
ROCK ISLAND COUNTY, ILLINOIS,
AND THE
ADJACENT TERRITORY.

*SHOWING THE GEOGRAPHICAL AND VERTICAL RANGE
OF THE FOSSILS OF THE NIAGARA, CORNIFEROUS,
AND HAMILTON GROUPS OF ROCKS,
AND THE CHEMUNG GROUP AT
BURLINGTON, IOWA.*

WITH SUPPLEMENT.

By A. S. TIFFANY.

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GEOLOGY

— OF —

SCOTT COUNTY, IOWA, & ROCK ISLAND COUNTY, ILLINOIS,

AND ADJACENT TERRITORY.

BY A. S. TIFFANY.

The Mississippi River divides the above-named counties. It has abraded its channel for a considerable depth in the Upper Silurian and Devonian formations, having cut out most of the coal-measures, where they repose unconformably on many members of the above formations. The strata all have a dip to the south and west greater than the fall of the river, and disappear below the bed of the stream, the same as the inferior strata do to the north as far as Guttenberg, and as the superior strata dips south to St. Louis, with the exception of the Silurian fold at Grafton.

The lowest formation in the above counties is the Niagara limestone. It makes its appearance on the Illinois shore, about two miles west of Hampton, with the conglomerate sand-rock of the coal-measures resting upon it. It covers the eastern portion of the county, except a small area where the coal-measures repose on it.

On the Iowa side of the river, it first appears a little above Valley City, where there is an outcrop of fifty-five feet of this formation, which is heavy-bedded, hard, rough, and destitute of fossils, as observed. From this place its strike is north-west to the center of Cleona Township. It outcrops on the south-west quarter of Section 3, where it is hard and rough, and on the north-east quarter of Section 6, which furnishes a good quality of building-stone, which probably belongs to the higher Water-lime group. All of Liberty Township is underlaid with the Niagara limestone, and it outcrops in many places.

The Wapsipinecon River has abraded its channel in the Niagara from Township 86, in Linn County, to the Mississippi River. It has asserted its claim to the old eroded valley that was denuded previous to the deposition of the Water-lime group. The same seems to be the case with the Maquoketa. This ancient erosion has brought many different members of the Niagara rocks to the surface, which is evidenced by the numerous outliers of the Water lime group reposing upon them.

There is a hiatus in the Upper Silurian rocks of Iowa. "The Onondaga Salt group in New York succeeds the Niagara limestone with a thickness of one thousand feet or more" (Hall's Iowa, p. 40) and the Guelph of Canada, with its one hundred and sixty feet (Logan's Canada, p. 338), are entirely wanting in Iowa. It would appear that all the time these twelve hundred feet of sedimentary strata were being deposited, the Niagara rocks of Iowa were land and subjected to denuding agencies.

The Niagara limestones near De Witt are hard, rough, and horizontally disposed. At Rothstein's Mill they are soft, shaly, and contain several species of *Rhynchonellas*. On the Wapsipinecon near Dixon, they are heavy-bedded, of medium hardness, and are horizontally disposed. Two miles south-east from the latter place, at an altitude probably of one hundred feet, they are thin-bedded of medium hardness, horizontally disposed, and capped with a partially eroded strata of the Water-lime group. There is a lime-kiln at this place. The upper strata is not used for burning. A short distance east of this place the limestones are hard, rough, and heavy-bedded. At Big Rock the creek has made a deep cut into hard, even-bedded horizontal limestones. At Massillon the outcrop of the Niagara is a soft and shaly mass of Crinoid joints, with casts of *Cyathocrinus*. At Oxford Junction, on the slope, the outcrop is filled with casts of *Pentamerus oblongus*. Higher up on this slope, the farmers have to drill their wells eighty to one hundred feet, to a level with the water in the Wapsipinecon. The rock is soft and porous. This is in Township 83 north, Range 2 west. Continuing up this slope for half a mile, a hard, compact silicate of limestone outcrops. They are even-bedded in strata of from eighteen to thirty inches. They extend west and north, and cover an area of nearly twenty square miles.

Some four miles west of the eastern outcrop, there are several sink-holes where the water has found a course through the joints of

these arenaceous limestones to the porous beds below, and thus finds a subterraneous passage to the river. We should judge that there is about eighty feet, or more, of this formation remaining, which to the south and east has been entirely cut out by erosion.

Six miles up the Wapsipinecon from Oxford Junction there is a vertical outcrop of the same formation of more than forty feet on the north side of the river. On the south side there is a slope of one hundred feet of the Water-lime group.

There is no perceptible dip to the strata of this silicated rock at any place observed. Digested with hydrochloric acid, about half of its weight of pure white silica remains. Where the rock has been weathered out, many silicated corals remain on the surface. This silicated lime-rock would be valuable for bridge abutments and heavy masonry. It outcrops adjacent to the Chicago, Milwaukee & St. Paul Railway, south of Wyoming.

At Clay Mills, in Township 85 north, Range 1 west, the river has made a deep cut in the Niagara limestone. It has left many castellated pillars standing detached from the cliffs, weathered in gothic and picturesque forms, some of them leaning in different directions, as the base has yielded to erosion and pressure. The scenery is bold, grand, beautiful, and surpasses any observed in the prairie States. The cliffs attain an altitude, in some places, of nearly one hundred feet.

East of the mills a quarry was visited, on the top of the cliff, which proved to be working two strata of the Water-lime group. They were, respectively, twelve and fourteen inches,—the lowest members deposited at this place, and appeared to belong to the middle of the series, where they were deposited in full force, with no concretionary flints or cavities lined with calc-spar in them, which are always present in the lower members of this group. The Niagara rocks at this quarry immediately below could not be satisfactorily examined. They were mostly covered with drift and the débris of the quarry, and the vertical cliffs could not be assailed. The strata of the cliffs are horizontally disposed, not very hard, and appear to be a pretty high member of the group. The only fossils observed at this point were *Atrypa reticularis* and casts of *Pentamerus oblongus*.

There are, doubtless, higher members of the group at Delhi. The writer has a *Huronina*, collected at the latter place (*H. annulata*? Hall), which shows structure; it belongs to the family of *Polypi*.

On the road between Clay Mills and Wyoming, a ridge of chert was passed over which was over thirty feet in thickness, which had resisted erosion; while the paste which had once cemented them together had been washed away. This chert-bed represents a section of the Niagara rocks seen at no other place. The Niagara limestone at Rapids City represents a section lying between two faults, to be described further on. *Pleurotomaria rotuloides* Hall, *P. idia* Hall, *Dinobolus conradi* Hall, and *Straparollus mopsus* Hall, were collected at this place from rocks which the Government had taken from the river to deepen the channel.*

Half-way between this place and Port Byron, and half a mile above the upper fault, a small stream has made a deep cut in the limestone. A few rods further on a vertical outcrop of twenty feet may be seen, with a fissure from the top to an unknown depth, about ten feet in width, which has been filled with coal shales. A Niagara limestone boulder, pretty well rounded, containing a cubic yard or more, was enveloped with the shales. It has not fallen from the walls above, and must have had the help of ice to transport it.

Some explorations for coal in this fissure brought to light the beautiful fern *Magalopteris alata* (Andrews' Pal. of Ohio, Vol. II., pl. 47, fig. 3), which Professor Lesquereux gave the specific name of *Southwelli*, and assigned it to the subconglomerate coal. There are no subconglomerate coal deposits in this county.

In Port Byron, at the lime-kilns and quarry of Mr. Lyford, adjacent to the ferry, rock has been quarried to a depth of forty feet. The stone is heavy-bedded, rough, hard, and contains the internal and external casts of many fossils, mostly *Cephalopoda*. The rock dips to the south-west. This is the only place where a dip to the Niagara rocks has been perceptible. The fossils are peculiar to this locality, and this is a section of the Niagara observed nowhere else.

At Le Claire there are two quarries worked for burning into lime. They are more than a mile apart, and adjacent to the river. The rock is brecciated and jointed, and the stratification is disguised. Most of the *Brachiopodas* in the accompanying list of fossils were collected at these quarries, largely at the upper one. In a ravine, running through the city from the bluff, the water has made a deep

*I have collected *P. rotuloides* from a deep shaft in the magnesian-lime rocks (calciferous) in Franklin County, Missouri.

cut, showing the thickness of the limestone at this place to be near one hundred feet to low water-mark in the river. Half a mile up this ravine the limestone may be seen in thin strata, horizontally disposed. On the road and along the shore from this place to Princeton the limestone may be seen in many places. About half-way to the latter place they are soft and shaly. The *Spirifera radiata* Sowerby is abundant at this place, but poorly preserved.

At Princeton the rocks are rather soft and thin-bedded; they are extensively used for cellar-walls and rough masonry.

At Cordova, on the Illinois side of the river, there is an outcrop of some thirty feet, filled with the joints of Crinoids, and seem to be the equivalent of the beds at Massillon.

Mr. Shaw reports the base of the Niagara geology of Whitesides County thus: "About a mile above Sterling, on the north bank of the river, a series of Niagara quarries are extensively worked. The formation here is worked down about thirty-five feet, and the rock is full of chert-bands and is speckled with dendrite markings. The layers, although thin-bedded, are so uncouth and rough that no mason could build them into a handsome wall. The bottom layers are of a dull green color, and soon pass into the underlying Cincinnati shales." (Geology of Illinois, Vol. V., p. 149.) "At Fulton City the upper part of the quarry, at least, is a friable yellow-colored or ocherous limestone, sometimes porous or sponge-like." (P. 151.) This last appears to be the equivalent of the slope above Oxford, referred to above.

By the excellent geological map that accompanies the Illinois report we learn that the Niagara rocks rise to the east, and the Cincinnati shales come to the surface twenty-two miles east of Albany, eighteen miles east of Port Byron, and sixteen miles east of Rapids City.

All of the eastern outcrops of the Trenton are at higher altitudes than are the Niagara rocks in the bed of the Mississippi at the west of them. These several places show a dip to the Niagara rocks from east to west, which is found to be continued into Iowa, where the Niagara rocks dip below and are succeeded by the Devonian to the west of them at lower sea-levels, from Buchanan County to Muscatine County. At Dubuque, low water in the Mississippi is six hundred and ten feet above sea-level. The Trenton limestone rises thirty feet, and the Galena limestone two hundred and fifty feet, Hudson River shales fifty feet, making the base of the Niagara nine

hundred and forty feet above sea-level. (Hall's Iowa, pp. 287, 289, and 291.)

"The French mounds are eminences between the middle and south forks of the Little Maquoketa," eleven hundred and sixty feet; "Sherrill's mound a little over twelve hundred and ten feet." (Hall's Iowa, p. 13.) These mounds are capped with Niagara limestone — elevation at Manchester, nine hundred and fifty feet; at Winthrop, ten hundred and fifty-three feet; at Independence, nine hundred and twenty-one feet (U. S. Bulletin, No. 5), where the Niagara is covered with the Devonian.

The Niagara limestone has disappeared below the Devonian ten miles east of Independence. Thus, it may be seen that, in the distance of fifty miles, the Niagara rocks dip to the west more than their entire thickness, whatever that may be. The Mississippi at Clinton, high water, five hundred and seventy-eight feet; summit between the Mississippi and Wapsipinecon, seven hundred and twenty-five feet; summit between the Wapsipinecon and Cedar, nine hundred and ten feet; water in Cedar River at Cedar Rapids, seven hundred and seventeen feet. At this place the bed of the Cedar is well up in the Hamilton. The higher altitudes cited are Niagara: At Wilton Station, on Chicago, Rock Island & Pacific Railway, six hundred and fifty-four feet; railroad track at Lowery's lime-kiln, five miles north-west, seven hundred and eighty-eight feet. The Niagara limestone outcrops twenty-five feet higher, bringing it to an altitude of eight hundred and thirteen feet. This is three miles north and one and one-half miles east of Moscow, at which place the Cedar River has its bed in the Hamilton elevation six hundred and thirty-four feet.

The Niagara formation invades the Devonian, on Professor Hall's map, on an east and west line, twenty miles; and on Professor White's map it is the same.

When we consider that the Mississippi River occupies an old eroded basin, as will be evident when we discuss the coal-measure deposit, it may be seen that the Niagara limestones at Le Claire and Port Byron were land, and subject to erosion, and were planed down to nearly their present level before the coal-measures were deposited. It is probable that the Niagara limestone attains the greatest thickness in Delaware County, which we would estimate at more than six hundred and fifty feet. If it has a uniform dip to the west of ten feet to the mile, as it appears it may have, it will give it a thick-

ness of more than twelve hundred feet. The dip from east to west, of ten feet to the mile, would place the Le Claire quarries, that are used for burning into lime, one hundred and fifty feet above the base of the group. That they occupy a pretty low horizon in the group, is evidenced by the following list of fossils collected at that place. The margin is marked "P." for Port Byron, and "L." for Le Claire. It appears that the Port Byron beds may have slid from a higher horizon, caused by the faults which are situated a short distance below. In a collection of ninety-seven species of fossils, made at Bridgeport, Illinois, we find only ten in the Le Claire list and one in the Port Byron list. In a collection of twelve species, made seven miles west of Chicago, near the Chicago, Burlington & Quincy Railway, we find only three in the Le Claire list and one in the Port Byron list. This last quarry is lower than the Bridgeport beds, and the petroleum-beds further north are still lower.

NIAGARA FOSSILS OF LE CLAIRE AND PORT BYRON.

P. ATRYPA, reticularis, Linn. Ni.	L. CYRTOCERAS, lucillum, Hall. . . Ni.
L. obtusa, Hall. Tr.	P. laterale, Hall. Ni.
L. AMBONYCHIA, acutirostris, Hall. Ni.	P. myrice, Hall and W. Ni.
L. mytiliformis, Hall. Cl.	L. macrostomum, Hall. Tr.
L. ANASTROPHIA, brevirostris, Sow- erby. Ni.	P. pucillum, Hall. Ni.
L. internascens, Hall. Cl.	L. rigidum, Hall. Ni.
L. AVICULA, emacerata, Hall. Cl.	P. subrectum, Hall. L. H.
L. P. rhomboidea, Hall. Cl.	five undetermined species.
L. subplana, Hall. Ni.	L. CYCLONEMA, sulcatum, Hall. . Gu.
L. trentonensis, Conrad. Tr.	L. elivatum, Hall. Ni.
L. undata, Hall. Ni.	L. DIPLOCERAS? new species.
P. BUCANIA, sulcatum, Emmons. Tr.	L. DIPHYPHILLUM, caspitosum, H. Ni.
P. BELLEROPHON, undetermined.	L. DINOBOLUS, conradi, Hall. . . Ni.
P. BUCANIA, sulcatina, Emmons. Tr.	P. ENDOCERAS, protoforme, var. strangulatum, Hall. Tr.
L. BEYRCHID, granulosa, Hall. Ni.	L. FAVOCITES, favosus, Goldfuss. Ni.
P. CAMEROCERAS, trentonensis, Con- rad. Tr.	L. hispidus, Rominger. Ni.
P. CALYMENE, blumenbachi, Bron. Ni.	L. niagaraensis, Hall. Ni.
L. CANNAPORA, justiformis, Hall. Cl.	Drift. venustus, Hall. Ni.
L. CLADOPORA, reticulata, Hall. . Ni.	L. FENISTELLA, acmea, Hall. Ni.
L. CORNULITES, flexuosus, Hall. . Cl.	P. GOMPHOCERAS, scrinium, Hall. Ni.
P. CHONOPHYLLUM, niagaraensis, Hall. Ni.	P. eos, Hall. Cl.
L. CYRTOLITES, undetermined.	L. HOLOPEA, delicula, Hall. Calcifer.
L. CYPRICARDITES, latus, Hall. . Tr.	Drift. HALYCITES, catinula, Linn. Ni.
L. obsoletus, Hall. Cl.	L. HELIOLITES, elegans, Hall. . . Ni.
L. quadrilateralis, Hall. Ni.	P. pyriformis, Guett. Ni.
P. CYRTOCERAS, brevicorne, Hall. Ni.	P. spinopora, Hall. Ni.
L. constrictostriatum, Hall. . . Tr.	L. LIMOPTERA? cancelata, var. occi- dens, Hall. Ni.
L. dardanus, Hall. Ni.	L. LEFERDITIA, fonticola, Hall. . Ni.
L. fosteri, Hall. Ni.	L. LYRODESMA, pulchillum, Hall. . Hud. Riv.
	L. LIMARIA, laminata, Hall. Ni.

- L. MERISTELLA, cylindrica, Hall. Cl.
and Ni.
L. intermedia, Hall. Cl.
L. MERISTINA, naviformis, Hall. Cl.
L. nitada, Hall. Ni.
L. MODIOLOPSIS, recta, Hall. Ni.
L. subalatus, Hall. Cl.
L. MURCHISONIA, gracilis, Hall. Tr.
L. conradi, Hall. Ni.
P. subalatus, Conrad. Tr.
L. P. teritiformis, Billings. Hud. Riv.
L. terebralis, Hall. Coralline.
P. MYTILARCA, sigillum, Hall. Ni.
L. ONCOCERAS, constrictum, Hall. Tr.
P. expansum, Hall. Coralline.
P. orcas, Hall. Ni.
P. subrectum, Hall. Cl.
four undetermined species.
P. ORTHOCERAS, abruptum, Hall. Cl.
P. annutatum, Sowerby. Cl.
P. clavatum, Hall. Cl.
L. junceum, Hall. Tr.
P. helderbergiae, Hall. L. Helder.
L. lamellosum, Hall. H. Riv.
P. imbricatum, Sowerby. Ni.
P. L. simulator, Hall. Ni.
P. vigultatum, Hall. Ni.
P. imbricatum, Sowerby. Ni.
L. undetermined species.
Genera undetermined.
L. ORTHIS, fasiata, Hall. Ni.
L. hybrida, Sowerby. Ni.
L. pectinella, Conrad. Tr.
P. rugiplicata, Hall. Ni.
L. PENTAMERUS, chicagoensis, Win.
and Marcy. Ni.
L. multicostatus, Hall. Ni.
L. occidentallus, Hall. Ni.
L. oblongus, Sowerby. Cl.
L. pergibbosus, Hall and Whit-
field. Ni.
P. ventrius, Hall. Ni.
PLEUROTOMARIA (Straparollus),
ida, Hall. Ni.
L. cassi, Meek and Worthen. Ni.
L. occidentis, Hall. Ni.
R. C. rotuloides, Hall. Tr.
P. solaroides, Hall. Guelph.
PLEUROTOMARIA (Straparollus),
L. substellistriata, Hall. Tr.
L. umbilicata, Hall. Chazy.
L. POSIDONIA, alata, Hall. Cl.
L. POSIDONOMYA, rhomboidea, Hall.
Ni.
L. PHRAGMOCERAS, nestor, Hall. Ni.
P. L. parvum, Hall and Whitfield. Ni.
L. PTEROTHECA, anatiformis, Hall.
Tr.
L. PTERINEA, brisca, Hall. Ni.
L. PYRENOMÆUS, cuneata, Hall. Ni.
L. RAPHISTOMA, lenticularis, Em-
mons. Tr.
L. RHYNCHONELLA, æquiradiata,
Hall. Cl.
L. P. neglecta, Hall. Ni.
L. plicatula, Hall. Cl.
L. SPIRIFERA, crispus, Hisinger. Ni.
3 m. above L. radiata, Sowerby. Ni.
L. gibbosa, Hall. Ni.
L. meta, Hall. Ni.
L. plicatella, var. radiata, Sow. Ni.
L. radiata, Sowerby. Ni.
L. trapisodialis, Hisinger. Ni.
L. STROMATOPORA, concentrica,
Gold. Ni.
L. calycula, Hall. Ni.
STRAPAROLLUS, mopsus, Hall. Ni.
STROPHOMENA, prisca, Hall. Cl.
L. depressa, Sowerby. Ni.
L. corugata, Conrad. Cl.
P. rhomboidalis, Whalerburg. Ni.
L. STROPHODONTA, inæquistrieta,
Conrad. Cor.
L. profunda, Hall. Ni.
L. prisca, Hall. Cl.
L. striata, Hall. Ni.
L. TRIMERELLA, acuminate, Bil-
lings. Guelph.
L. grandis, Billings. Guelph.
P. ohioensis, Meek. Ni.
L. species undetermined.
P. TROCHOCERAS, desplainense, Mc-
Chesny. Ni.
L. TROCHONEMA, pauper, Hall. Ni.
L. TELLINOMYA, curta, Hall. Cl.
P. ZAPHRENTES, bilateralis, Hall. Cl.

Of the above list of 154 species, there has been described as occurring in the Calcareous group, 1; Trenton, 25; Chazy, 1; Hudson River, 3; Clinton, 26; Niagara, 73; Guelph, 4; Coralline and Helderburg, 4; Corniferous, 1; undetermined species, 16; undetermined genera, 3.

THE WATER-LIME GROUP.

The even-bedded magnesian buff limestones of Le Claire and Anamosa, and their equivalents, in numerous outliers in Scott, Jackson, Jones, and Delaware counties, are capable of furnishing an abundance of dimension stone of the very best quality. They are easier wrought into the required shape, and more enduring, than any other stone that has been used in the Upper Mississippi Valley. They are of a light cream color, contain no sulphurets, and the color remains unchanged by exposure. They have been deposited unconformably on many different members of the Niagara limestone.

The Niagara limestones have been land, and subject to erosion, while more than one thousand feet of saline rocks had been deposited in New York State, and the same in Canada, and two hundred feet of the Guelph group in the latter place. The saline rocks in Canada were deposit that went on very slowly, with its six beds of rock-salt, measuring one hundred and twenty-six feet.* Through all this long period the Niagara rocks were land, subject to denudation, and became deeply scored and grooved by the channels of drainage.

When subsidence had brought the Niagara rocks below the ocean again, the deposition of the rocks under consideration took place, filling the depressions in the eroded Niagara rocks. Being thus protected by the older and harder Niagara rocks, they have escaped subsequent erosion, while the higher portion, which once connected those numerous outliers, has been swept away. There are two of those outliers at Le Claire. The one in the city has been worked to a vertical depth of thirty feet. It has furnished strata of three, four, five, six, seven, eight, nine, ten, twelve, fourteen, and seventeen inches. The formation rises higher than the quarrying, and extends west and shows itself in block 35. The upper section of the group was deposited at this place. On Quarry Creek, one mile above, the creek has made a deep and broad cut in this formation. Quarries at this place furnished stone for the jail at Rock Island in 1855, for the Davenport jail in 1856, and for the Burlington bridge in 1864. These structures are all intact at the present time, and do not show the impress of the hand of time. This quarry has a ver-

* Geology of Canada, 1876, 1877, pp. 230-232.

tical face of forty feet, the strata ranging from eighteen to thirty-six inches. The stone splits with great facility, either on the line of deposition or transversely. A little further east, on Mr. Tillman's place, the quarry rock may be seen resting on heavy, rough strata of the Niagara limestone.

The quarries at Le Claire are capable of furnishing an unlimited supply of the best quality of dimension stone. It is the lower section of the deposit that has been quarried at this place. The higher, thinner strata may be covered with drift on the slopes farther up the creek. There are numerous outliers of this formation on both sides of the Wapsipinecon. At Binford's quarry, half a mile north-east of Rothstein's Mill, on the bluff, in Township 80, Range 1 east, about eighteen feet of this formation is quarried. The strata range from six to eighteen inches. They are smooth-bedded, numerous rents indicating disturbance. They are underlaid with two strata of Niagara limestone of thirty-six inches each, which are hard, and break with a rough fracture. Only the upper section of the Water-lime group was deposited at this place.

Half a mile north of Rothstein's Mill, thin, shaly layers of this formation were seen. They rest on the *Rhynconella* section of the Niagara group. One mile farther in the same direction is a quarry worked in the lower section of the Water-lime group. On the opposite side of the Wapsipinecon, in Section 8, Allen's Grove Township, Mr. Snider works a quarry where twenty feet of the base of the group outcrops on the bank of the river. Two miles west from this place a quarry is worked in a small outlier; the strata are thin, and dip to the east at an angle of some twenty degrees, and represent a section high up in the group, which has fallen from a higher altitude.

To the south and west, the hard, rough Niagara rocks crop out at a higher level, and at a lower level to the east. A similar slide may be seen at Port Byron, between the railroad and the river, dipping to the west. The area of both of these slides is very limited. In Liberty Township quarries are worked in this formation—in Sections 18 and 33.

In Pleasant Valley Township, in the south-east quarter of Section 10, on land owned by Otto Klug, there is a quarry which has a vertical face of eighteen feet. A little south, on Crow Creek, twenty feet of hard, rough Niagara limestone are exposed. No stratification was observed.

In Jones County, in Township 83, Range 2 west, there are seven outcrops of this formation. At Horton's quarry, in Section 12, the strata range from eight to sixteen inches. There are numerous rents in the quarry, and the water finds a subterraneous passage. This quarry seems to be a middle section of the group. A few rods south of the quarry, towards the Wapsipinecon River, the hard, rough Niagara limestones are exposed at a higher altitude than the quarry. South of the Wapsipinecon, in Section 11, there are three quarries, the upper one situated on a slope. A vertical depth of one hundred feet of stone may be quarried here, ranging from three to thirty-six inches. They rest upon the Niagara limestone a little above the water in the river. Between this and the next quarry the water of a small stream has cut through the quarry rock and some six feet into the Niagara limestone. This elevation is in consequence of the slope of the river. There may be a dip to the quarry rock up the river to the west, but it is not perceptible to the eye. The third quarry, which is farther down the stream, is a slide, it dips about thirty degrees to the south-east, and is but little elevated above the water in the river. The stone exposed belongs above the middle of the group. It is detached from the quarries above.

At Rome a quarry is worked in the base of the group, and concretionary flints are very numerous in the stone, and detract from its value. Stone was seen in the basement of barns, quarried east of Wyoming, where the strata ranged from sixteen to twenty-four inches, which could not be surpassed for excellence. The quarry was not visited.

In September, 1872, Messrs. Baldwin and Wood invested in a quarry at Delhi. The former was civil engineer, and the latter superintendent, of the Davenport & St. Paul Railroad. Hon. Geo. H. French was president. Mr. French showed the writer a small cube of stone the proprietors had brought from their new quarry, and claimed that it represented a section of forty feet. The writer ventured the opinion that there were very few feet of quarry stone at that place. Messrs. Baldwin and Wood reexamined the place and reaffirmed the forty feet, and the writer reaffirmed to Mr. French the opinion previously expressed, though never having been nearer than twenty miles of that place. When the quarry was developed there proved to be but two strata of quarry stone, of twelve and fourteen inches each—the underlying Niagara rock being light gray, very rough, and somewhat porous.

The excellent geological reports of Illinois failed to recognize any Silurian deposits superior to the Niagara group. This will not be considered strange when we consider that the State of Illinois takes in only a few miles in width of the lower section of the Niagara group, and that they are succeeded east by the Cincinnati shales — the Water-lime group having been almost entirely eroded out. • The small slide at Port Byron is the only place the writer has seen any of this formation in Illinois.

The geological survey of the State of Iowa, by Prof. C. A. White, was so cramped for time and means that no part of the work could be done in detail, unless all the time allowed for the survey of the State had been devoted to two or three counties. The Legislature, which authorizes these surveys, seldom appreciates the magnitude or importance of the work. "Thus, the full realization of the objects for which the people, through their representatives, support these works, are seldom attained." (White's Iowa, Vol. I., preface.) Thus it will not seem strange that Professor White classified all the Upper Silurian rocks of Iowa as belonging to the "Niagara period alone" (Vol. I., p. 182).

No organic remains up to this time having been discovered to settle their true horizon, geologists were left with only lithology and superposition as guides to their true horizon. The writer had been diligently seeking for organic remains in this formation for many years. He was at last rewarded, in February, 1882, by finding great numbers of fossils in stone from the base of the Anamosa quarries. The stratum which bore the fossils was three feet thick, the lower six inches being a mass of fossils, all of the type of the Water-lime group, and all of them being internal or external casts. We have thus far determined the following species: *Avicula-rugosa*, Conrad — this fossil would seem to belong to Hall's new genera, *Actinopteria* (Pal. N. Y., Vol. V., pt. 1, pl. 1, p. 107, 1883); *Merista* (*Meristella*) *sulcata*, Hall; *Spirifera vanuxemi*, Hall; *Leperditia alta*, Conrad (Geology of N. Y., 4th dist., p. 142); and *Stropostylus elegans*, Hall (Pal. N. Y., Vol. III., pl. 55, p. 304).

The numerous outliers of these even-bedded quarry rocks, deposited unconformably on many different members of the Niagara limestones, ought to be sufficient to prove them to be a later and superior deposit; and the organic remains found at the base of the group place them as the equivalent of the New York Water-lime group.

THE CORNIFEROUS, OR UPPER HELDERBERG.

This is the next rock in the ascending order. As these two names are synonymous, we choose the former as being the least cumbersome. This formation, in its eastern extension, is first met with a little east of Crow Creek, in Pleasant Valley Township, on the shore of the Mississippi River. It is separated from the Niagara limestones by a fault, a little more than two miles in width, filled with coal-measure deposits. The formation at this place is a dark gray, hard, and somewhat arenaceous limestone. It is the lowest member of the group that is known to outcrop at any place. Different members of this formation may be seen along the shore, at low water, from this place to Rockingham, three miles west of Davenport, and for two miles further west on the slope of the bluff, at Eagle Point. Eighty rods further west a small stream runs over coal-measure sand-rock and shale, at a lower level by more than fifty feet. These limestones are exposed on Duck Creek, north of Davenport, and from thence to its mouth, where they may be seen in great force. The rock at this place is a breccia, drab and hair-brown, and takes a good polish. It represents a section some seventy feet below the top of the deposit.

On the Illinois side of the river, about three miles west of Hampton, the Devonian rocks may be seen with coal shales resting upon them, and from thence to Moline, and also near Green River station, in the bed of that stream.

Fulton's quarry, in East Davenport, shows the following section :

No. 1, section eroded from the top of the quarry.....	20 feet.
No. 2, heavy-bedded gray limestone.....	40 feet.
No. 3, thin strata, eight to twelve inches lithograph stone..	10 feet.
No. 4, breccia band, thin strata, drab and hair-brown.....	8 feet.
No. 5, variegated marble, thin strata, crystallized	4 feet.
No. 6, slope to low water in the river	12 feet.
To bottom of river.....	8 feet.

102 feet.

There is a heavier outcrop in Camp McClellan grounds, which is mostly covered with drift.

Where Nos. 4 and 5 come together they are sometimes united. Below No. 5 there is a cream-colored stratum, eight inches thick,

and softer than any other stratum in the group—a thin stratum peppered with small darker spots — may be organic. Very low water in the river exposes a stratum of fine-grained, compact limestone, of which the thickness is unknown, and is filled with outline impressions of a small Gasteropod. These lower strata are now concealed by the Chicago, Milwaukee & St. Paul Railway. All the above thin strata are warped, contorted, and rough on their surfaces.

No. 3 of the above section is a light drab, fine-grained, compact, argillaceous limestone, where the outcrop has been long exposed. It splits into thin laminae, and is the stratum Professor Hall refers to on page 86 of his report. When polished it is as fine and smooth as ivory, and makes the darkest quicklime of any member of the Corniferous group, but is less enduring in masonry or macadam. The quarrymen call it flint. No. 4 is of the same character, except its brecciated structure and color. The hair-brown spots, with its endless variety of forms, make it very ornamental when polished. It occurs on the surface of the Rock Island Arsenal grounds where the shops have been erected. It marks an unmistakable horizon of the Corniferous group.

Colonel Flagler, in constructing the Government shops, found an eroded basin filled with coal shales, the width of which was nine hundred feet and the depth seventy feet, with the length explored of more than one thousand feet — the extension in both directions being unknown.

Many large limestone boulders were imbedded in the shale, some of which, Colonel Flagler says, would weigh more than twenty tons. They were broken up and used for filling and macadam, none of which can be found. It is not known to what geological age they belonged.

The shops have a frontage to the west of three hundred feet each, with an avenue of three hundred feet in width between them.

This eroded basin involved the foundations of six of the ten shops. At the south-west corner of shop H, at the depth of seventy feet, rock was not reached, and a probe was run down fifteen feet further without finding rock; in consequence of which Colonel Flagler caused an arch to be sprung over this corner of about twenty feet span.



There are no faults or folds in this formation on the island or on either shore. The slight dip of the rock south and west is not perceptible. The walls are very irregular lengthwise and approximately vertical. In some parts of this basin Colonel Flagler found the clay and arenaceous shales firm enough to build on, and only parts of this basin were excavated down to the limestone. When the Rock Island bridge was being constructed, coal shales were found in place twenty-five feet below low water, at pier No. 5. On the island shore, adjacent, the Corniferous limestones rise in a vertical wall twenty-one feet above low water. On a line between these places, on the north shore of the island and west of the old bridge, coal shales, with *Lepidostrobus* and other coal-plants, and fire-clay are found in place, and no Devonian rocks are in sight for sixty rods.

This eroded basin points with certainty to the time when a waterfall existed at this place which was the peer of the Niagara. This leads to the inquiry, What superior strata had the hardness and endurance to cause such a fall? There is a hard, calcareous stratum well up in the Hamilton that might have been the cause. It is more probable that the Burlington limestones extended east of this place, as they are now only forty miles distant to the west, at Columbus Junction, and may approach much nearer covered with drift. They are known to be in place at Iowa Falls, and the Keokuk highest beds of the group at Crawfordsville, Indiana. A line drawn between these places crosses the Mississippi six miles east of Rock Island. There can be no doubt that the contemporaneity of strata once connected these places, which are distant three hundred and sixty-five miles, and that the formation extended north and east of these places. The altitude of Iowa Falls is 1070 feet, and of Crawfordsville, 741 feet. If the Burlington beds were deposited here, they were more than 350 feet above the Corniferous. The soft, argillaceous beds of the Hamilton and Kinderhook would offer little resistance, and the falls would be vertical. Where the shops have been built, the limestones have been planed down seventy feet by erosion. The most western exposure of this group is in the southwest quarter of Section 24, Township 17 north, Range 3 west, in Rock Island County, on the river-bottoms. The bluffs above are conglomerate sand-rock.

At all the above-named exposures the upper fossiliferous strata have been cut out by erosion.

A charlatan who claimed to be a geologist directed Mr. Mosher, the owner of the above quarter-section, to seek for coal below this Corniferous lime-rock, and received \$25 for his deception.

There are three quarries in this formation west of the city. At these quarries numerous pot-holes have been excavated in the hard, Corniferous limestones, ten to fifteen feet deep and twenty to thirty feet in diameter. They are filled with arenaceous shales of the coal-measures, and have been eroded by the same agency that eroded the deep basin on the Rock Island Arsenal grounds.

At Cook's quarry a cave which existed in the Hamilton has been eroded out, leaving a portion of the stalagmite floor of considerable extent and ten inches thick. Mr. V. R. Carr, while acting as foreman at this quarry, found a piece of stalactite, which he gave to the Davenport Academy of Sciences. Some time after, he found another piece, the break of which fitted the first piece. These quarries have furnished a large supply of excellent building-stone, and have been profitable to their proprietors. Small crystals of sulphuret of zinc frequently occur in them. Churches and dwellings built of this stone show no signs of disintegration after thirty years of exposure. Frequent visits to these quarries for fifteen years, and watching the stone brought to the city for use, has rewarded the writer with many species of fossils illustrating the life of the lower Devonian period in this vicinity. No year has been more fruitful than the past one, and we hope in the future to enlarge the list. The following list of fossils are all labelled, with the authors of the genera and species, and the dates when they were defined, page, plate, and text-book, and the locality where collected.

The sections previously quoted, with the slope of the river and the dip of the rock from Crow Creek, estimating the dip at ten feet to the mile, will give a section of one hundred and eighty feet plus all that is below the water at the fault. We estimate the thickness at three hundred feet or more.

FOSSILS OF THE CORNIFEROUS GROUP COLLECTED IN SCOTT
COUNTY, IOWA, AND ROCK ISLAND COUNTY, ILLINOIS.

- ACTINOPTERA (*Pteronites*), decussata, Hall.....H.
Synonym, *Avicula cancellata*, Barris.....
- ACROPHYLLUM, oneidaensis, Billings.....Cor.
- ALVEOLITES, goldfussi, Billings...H.
squamosus, Billings.....Cor.
subramosus, Rominger.....Cor.
valorum, Meek.....Dev.
- AMBONYCHIA, acutirostris, Hall...Ni.
AMPLEXUS, yandelli, E. and H...Dev.
- ASTREOSPONGIA, hamiltonensis, M. and W.....H.
- ATHYRIS, vittata, Hall.....H.
- ATRYPA, aspera schlotheum.....Cor.
hystrix, Hall.....Chem.
reticularis, Linnaeus.....Cor.
- AVICULA, emacerata, Conrad....Ni.
rhomboidea, Hall.....Cl.
triquetra, Hall.....Onon.
- AULACOPHYLLUM, convergens, Hall, reflexum, Hall.....Cor.
princeps, Hall.....Cor.
praecipitum, Hall.....Cor.
- BELLEROPHON, patulus, Hall....H.
pelops, Hall.....Cor.
species undetermined.....
- BLOTHROPHYLLUM, promissum, Hall.....Cor.
species undetermined.....
- BUCANIA, profunda, Con. . . L. Helder.
- CALIOPORA, mummiiformis, Hall...Ni.
- CANNAPORA, justiformis, Hall...Cl.
- CENTRONELLA, glansfagea, Hall...Cor.
hecata, Billings.....Cor.
- CHÆTETES, species undetermined.
- CHONETES, lineata, Conrad...Cor.
logani, N. and Praten.....Bur.
- CHONOPHYLLUM, niagarensis, Hall, Ni. vadum, Hall.....Cor.
- CLADOPORA, labiosa, Billings...Cor.
lichenoides, Rominger.....Cor.
fibrosa, Hall.....Ni.
mummiiformis, Hall.....Ni.
pinguis, Rominger.....Cor.
pulchra, Rominger.....Cor.
robusta, Rominger.....Cor.
- CLISIOPHYLLUM, convergens, Hall, conigera, Hall.....Cor.
ohioense, Nicholson.....Cor.
- CLISIOPHYLLUM (Acrophyllum), oneidaensis, Billings.....Cor.
- CRANIA, bordendi, Hall.....Dev.
- CRYPTONELLA, rectirostra, Hall...H.
- COLLONEMA, imitator, Hall.....Cor.
- CELOSPIRA, concava, Hall.....Cor.
- CYATHOPHYLLUM, arctifosa, Hall, Cor. clintonensis, Hall.....Cor.
coalitum, Hall.....Cor.
conigera, Hall.....Cor.
cornicula, Rominger.....Cor.
davidsoni, Hall.....H.
diantheus, Goldfuss.....Onon.
digitatus, Goldfuss.....Onon.
houghtoni, Rominger.....Cor.
impositum, Hall.....Cor.
juvinis, Rominger.....Cor.
radicula, Rominger.....Ni.
rugosum, Edw. and Haime...Cor.
nobilis.....Cor.
niagarensis, Rominger.....Ni.
scyphus, Rominger.....Cor.
many undetermined species....
- CYSTIPHYLLUM, americanum, Edw. and Haime.....H.
ohioense, Nicholson.....Cor.
lateradum, Hall.....Cor.
sulcatum, Billings.....Cor.
three undetermined species....
- CTENOCANTHUS, new species.....
- CYRTINA, umbonata, Hall.....H.
- CYPRICARDINIA, sublamilosa, Hall, L. Helder.
- CYCLONEMA, sulcatum, Hall...Guelph.
- CVRTOCERAS, nereus, Hall....Cor.
validum, Hall.....Scho. Grit.
cytum, Hall.....Cor.
- DENDROPORA, neglecta, Rom....Cor.
- DIPHYPHYLLUM, archiaci, Billings, Cor. apertum, Hall.....Cor.
rectiseptatum, Rominger.....H.
stramineum, Billings.....Cor.
- DICTYOSTOMA, undulata, Nich...Ni.
undetermined species.....
- EUOMPHALUS, new species.....
- FAVOSITES, basalticus, Goldfuss...Cor.
canadensis, Billings.....Cor.
digitatus, Rominger.....H.
emmonsii, Rominger.....Cor.
epidermatis, Rominger.....Cor.
limitaris, Rominger.....Cor.
- FAVOSITES (Emonsia), hemispherica, Troost.....Cor.
polymorpha, Goldfuss.....Cor.
- GOMPHOCERAS, clavatum, Hall, Scho. Grit.
conradi, Hall.....H.
eximium, Hall.....Cor.
beta, Hall.....Scho. Grit.
fisheri, Hall.....H.
lunatum, Hall.....Cor.

- GOMPHOCERAS, oviforme, Hall. H.
two undetermined species.
- HELEOLITES, elegans, Hall. Ni.
HELIOPHYLLUM, fecundum, Hall, Cor.
ISONEMA, humilis, Meek. Cor.
LEIOPTERA, laevis, Hall. H.
two undetermined species.
- LEIORHYNCHUS, new species.
- LIMARIA, laminata, Hall. Ni.
LITHOSTROTIAN, new species.
- LOXONEMA, species undetermined.
MACROPETALICHTHIS, skull and
dermal plate. Cor.
MERISTELLA, doris, Hall. Cor.
lenta, Hall. Oris.
rostrata, Hall. Tully.
scitula, Hall. Cor.
species undetermined.
- MICHÆLINA, favostoides, Billings, Cor.
MONTICULIPORA.
- NATICOPSIS, humilis, Meek. Cor.
ORTHIS, macfarlani, Meek. H.?
iowensis, Hall. H.
OMPHYMA, species? Rafinesque. Ni.
PARACYCLAS, ellipticus, var. occi-
dentalis, Hall. Cor.
liratus, Conrad. Cor.
ohioensis, Meek. Cor.
new species.
- PENTAMERUS, comis, Owen. H.
PENTREMITES, species undetermined.
PENTAMERELLA, dubia, Hall. H.?
arata, Conrad. Cor.
micula, Hall. H.
new species.
- PLATYSTOMA, aplata, Hall. Scho. Grit.
lineata, Conrad. Cor.
lineata, var. sinuosum, Hall. H.
pleurotoma, Hall. Cor.
sinuosum, Hall. H.
PLATYCERAS, carinatum, Hall. Cor.
conicum, Hall. H.
dumosum, var. rarispinum, Hall. Cor.
ereotum, Hall. H.
gibbosum, Hall. L. Helder.
symmetricum, Hall. Cor.
PLEUROTOMARIA, arata, Hall, ...
Scho. Grit.
aplata, Hall. Cor.
hebe, Hall. Cor.
lucina, Hall. Cor.
rotalia, Hall. Cor.
lucina, var. clausa, Hall. Cor.
species undetermined.
- PRODUCTELLA, exanthema, Hall. H.
navicella, Hall. Cor.
spinulicosta, Hall. H.
two undetermined species.
- PHILLIPASTREA, gigas, Owen. Cor.
verneuili, Edw. and Haime. H.
- PTYCTODUS, calceolus, Newberry
and W. H.
PROETUS, canaliculatus, Hall. Cor.
clarus, Hall. Cor.
crassimarginatus, Hall. Cor.
rowi, Green. H.
hesione, Hall. Scho. Grit.
prouti, Shumard. H.
Synonym, *davenportensis*, Barris.
Mr. Shumard undoubtedly ob-
tained his type specimen from
the Corniferous.
verneuili, Hall. Cor.
QUENSTEDTIA, umbellifera, Rom., Cor.
RENSSELAERIA, johanni, Hall. Cor.
RHINOPORA, verrucosa, Hall. Cl.
RHYNCHONELLA, venustula, Hall, Tul.
Synonym, *Rhynchonella interme-
dia*, Barris.
- SPIRIFERA, fimbriata, Conrad. Cor.
duodonaria, Hall. Cor.
euruteinis, Owen. Cor.
gregaria, Clapp. Cor.
macrea, Hall. Cor.
maia, Billings. Cor.
macrothyris, Hall. Cor.
mucronata, Conrad. H.
manni, Hall. Cor.
perlamellosa, Hall. L. Helder.
subundiferous, M. and W. H.
unica, Hall. Cor.
varicosa, Hall. Cor.
- SPONGIA.
- STRAPAROLLUS, inops, Hall. Cor.
STREPTELASMA, coarctatum, Hall, Cor.
coalitum, Hall. Cor.
corniculum, Hall. Tr.
lateradum, Hall. Cor.
simplex, Hall. Cor.
- STREPTORHYNCHUS, pandora, Bil-
lings. Cor.
STROPHONELLA, ampla, ? Hall. Cor.
STROPHODONTA, concava, Hall. Cor.
hemispherica, Hall. Cor.
inæquistriata, Hall. Cor.
inæquiradiata, Conrad. Cor.
junia, Hall. Cor.
magnifica, Hall. Oris.
patersonia, Hall. Cor.
STROMATOPORA, nodulata, Nich., Cor.
ponderosa, Nicholson. Cor.
substriatella, Nicholson. Cor.
STROMBODES, pygmæus, Rominger, Ni.
STROPHOSTYLUS, cancellatus, M.
and W. Oris.
unicus, Hall. Scho. Grit.
three new species.
- SYRINGOPORA, nobilis, Billings. Cor.
TROCHOCERAS, expansus, Hall. Cor.
obliquatum, Hall. Cor.

TEREBRATULA, elia, Hall.....Cor.	ZAPHRENTIS, exigua, Billings....Cor.
harmonia, Hall.....Cor.	gigantea, Rominger.....Cor.
navicella, Hall.....H.	herteri, Hall.....Cor.
sulivanta, Hall.....Cor.	nitadi, Hall.....Cor.
TELLINOMYA, species undetermined.	ohioensis, Nicholson.....Cor.
THECA, ramosa, Rominger.....Cor.	prolifera, Billings.....Cor.
ZAPHRENTIS, bilaterale, Hall.....Cl.	ponderosa, Hall.....Cor.
cruciforme, Hall.....Cor.	simplex, Hall.....H.
compressa, Hall.....Cor.	subconstricta, Hall.....Cor.
concava, Rominger.....Cor.	wortheni, Nicholson.....Cor.
conigera, Rominger.....Cor.	ungula, Rominger.....Cor.
edwardsi, Nicholson.....Cor.	

RECAPITULATION.—Of the 235 species in the above list, there have been described: From the Trenton, 1; Clinton, 3; Niagara, 14; Guelph, 1; Lower Helderberg, 5; Onondaga, 3; Schoharie Grit, 5; Oriskany, 3; Corniferous, 155; Hamilton, 33; Tully, 2; Chemung, 1; Burlington, 1; undetermined, 28.

No fossils have been published as having been collected in the Corniferous or Upper Helderberg in either of these counties in the Illinois or Iowa geological reports.

NOTE.—While the above was in press we collected the following additional species from the above counties:

CYRTOCERAS metallica, Hall, U. Helder.	PRODUCTELLA, truncata, Hall,
DIPHYPHYLLUM, simcoense, Bill., Cor.	Mar. Shale.
EUOMPHALUS, planodiscus, Hall,	ORTHIS, impressa, Hall.....Chem.
Mar. Shale	lenticularis, Vanuxem.....Cor.
LOXINEMA, solida, Hall...Scho. Grit.	ORTHO CERAS, luxum, Hall, Scho. Grit.
MERISTELLA, nausuta, Conrad...Cor.	inoplatum, Hall.....U. Helder.
PHACOPS, rana, Green.....H.	SYRINGOPORA, pereligans, Bill...Cor.
PLATYCERAS, bucculentum, Hall...H.	

THE HAMILTON GROUP.

The most eastern outlier of the Hamilton shales on the Iowa side of the Mississippi River is in a ravine north of Bishop Cosgrove's residence; on the Illinois side of the river, at East Rock Island, where thirty feet of soft, argillaceous shales repose on the Corniferous. These shales are quite worthless for economic purposes, but they carry abundance of the common Hamilton fossils, such as have been described in the Iowa and Illinois reports, but none of the rare ones that the higher beds have furnished.

On the north side of Rock River, near Milan, Mr. Sears, in 1869, cut a canal in the Hamilton. The debris was spread on both banks. Many of the rare fossils in the accompanying list were collected there.

One mile east of Milan and south of the bluff road, Mill Creek has cut a deep gorge in the Hamilton limestone and shales. In

the lowest exposure there are numerous Crinoid joints, and a short distance up the creek some hard, calcareous bands have furnished stone for the bridge abutments at this place. Farther up the creek there are more than forty feet of the argillaceous shales, and there are two bands of four feet each of Crinoid joints. A mile and a half up the creek there is an outcrop of twenty feet of hard, gray limestones, barren of fossils. The Hamilton shales dip to the south up the creek, which places these hard limestones in the Hamilton group and gives a section at this place of more than one hundred feet. The starting-point at the bridge we estimate at fifty feet above the base. Two miles east of this place Mr. Graig has opened a quarry in the Hamilton shales. Many species of *Platyceras* were collected here, and a fish spine, new genus, which has been in Professor St. John's hands nearly four years, with other spines and teeth, and the writer has received no light in regard to any of them thus far. This is a section of the Hamilton the writer has seen at no other place.

On the road to Buffalo, two and a half miles east of the town, the Hamilton shales outcrop with considerable force. Mr. Sauer has opened a quarry on the slope of the bluff. The stone is a mass of white Crinoid joints, *Fenistella*, and other corals, cemented with a light buff or blue paste. It takes a very fair polish, and is highly prized by those who have table-tops, paper-weights, or hand specimens of it polished. There are more than thirty feet of this Crinoid section. No bodies have been collected at this place. The hard, conglomerate sand-rock rests upon it, having numerous white quartz water-worn pebbles imbedded in it. The long slope from the quarry to the river is covered with drift, except along the shore, where the common clay shales outcrop. The whole section at this place to low water is about eighty feet. A small stream at Linwood shows a section of forty feet of the soft, argillaceous shales above low water in the river. One and one-fourth miles up this ravine there are several strata, some eight or ten feet, of hard, pure, fine-grained limestones filled with *Spirifera perryanus*. At the Dodge ravine there is a section of ten feet of hard, Hamilton limestones. Half a mile up the ravine a quarry is worked in the blue shales, the equivalent of the lower quarry at Buffalo.

At and near Buffalo there are many different members of the Hamilton group exposed. The most of these members have been planed down previous to the deposition of the coal-measures, so

that it is quite impossible to determine what their maximum thickness has been. Along the levee at low water some ten feet of shales are exposed, largely made up of the separated valves of *Orthis*, showing this to have been an off-shore deposit of a shallow sea. Above this are six feet of Crinoid joints. They frequently lay straight on the surface of the strata for two feet and more in length, all connected, showing this to have been a quiet sea-bottom remote from shore.

Below, at Captain Clark's quarry, on Cedar Creek, there is a Crinoid band, some three feet thick, made up of thin strata. We collected *Elæacrinus meloniformis*, Barris, and *Megistocrinus latus*, Hall, at this place. There are about ten feet of strata between this and the next Crinoid bed, at the base of Captain Clark's quarry. *Aviculopecten pecteniformis*, Conrad, and some other rare fossils have been collected from these intervening strata. Captain Clark's quarry has furnished most of the *Crinoids* in the accompanying list. There are six feet of these Crinoid strata, ranging from two to six inches in thickness, which we believe to be the highest Crinoid bed in our Hamilton. Above this bed there are twelve feet of firm blue shales, in which there are many species of *Spirifera*, and an undetermined *Chonetes* is abundant.

Captain Clark has opened another quarry on the bluff, a little west of this. It has been worked to a depth of twelve feet, in a dark, rather hard, ferruginous strata, which, at the time of our visit, proved to be barren of fossils. Here we get a section of seventy-five feet without knowing where the bottom or the top of the Hamilton group is.

Half a mile west of this place a quarry has been opened. The upper stratum is a mass of *Centronellas*. It has been planed down. The rock and fossils are of equal hardness, and the fossils are worn down to the same plane. The quarry has been worked to a depth of ten feet, and the bottom is of the same character. The railroad grade shows the same formation for some distance beyond.

One and one-half miles west of Buffalo a creek comes in from the north. Near the river it runs over hard, gray Hamilton limestone. One mile up this stream the shales are soft and argillaceous. They decompose and give up their fossils in an excellent state of preservation. *Spirifera oweni* and *S. parryanus* were collected here. Half a mile above we get the *Spirifera euruteinis*,

var. *fornacula*. There are strata here filled with *Athyris vittata*, Hall. The upper strata have many species of *Strophodonta*, some of which are undescribed. The sandy shales of the coal-measures come in above.

About three miles west of this place, at Montpelier, a quarry is worked in a soft, even-bedded, yellow magnesian limestone. We have tested some of it having hydraulic properties — not sufficient to make a valuable cement. It is probable that some strata may be valuable for that purpose. Prof. Hall refers it to the Chemung, and gives it a section of "fifteen or twenty feet at the mouth of Pine Creek" (p. 89). He refers the "*Spirifera capax*" to it (p. 520), which Prof. Worthen and the writer regard as being internal casts of *S. parryanus* (Ills., V. 5, p. 223), and refers it to the Hamilton. The following fossils collected at this place seem to place it in the Hamilton group: *Atrypa reticularis*, *A. aspira*, *Spirifera gregaria*, *S. mucronata*, *S. parryanus*, *Ptyctodus calceolus*. This seems to be the highest member of the group in these two counties, and is immediately overlaid, at both of the above places, by fifty to eighty feet of conglomerate sand-rock.

Solon, in Johnson County, is situated on the divide between the Cedar and Iowa Rivers—railroad altitude, 784 feet. A quarry is worked in Hamilton limestones, having a face of forty feet, at an altitude of one hundred feet higher. It is six miles east to the Cedar River and four miles west to the Iowa River, both of them having excavated their beds in the Hamilton. Solon is eighteen miles north of Moscow and ten miles north of Iowa City. The Cedar has a slope of 25-12 feet per mile, making the water in the Cedar River east of Solon 678 feet above the sea; quarry near Solon, 884 feet; difference, 206 feet. The Iowa River has a slope of 31-12 feet per mile, making the water in the Iowa River at its nearest place 632 feet; difference, 252 feet, of which the mean is 234 feet of Hamilton at Solon, with the sections of the group below the beds of these streams and the portion denuded from above unknown. No evidence of an anticlinal at Solon was observed.

There is a soft, yellow, ferruginous arenaceous bed in the Hamilton. It is developed between Fairport and Muscatine, and also at Coralville, west of Iowa City. It contains numerous *Stromatopora*, *Favosites*, and other corals, and the *Euomphalus cyclostoma*, Hall, at both places, which is not found in any other member of the Hamilton group.

On the west side of the Cedar River, south of Cedar Rapids, there is an outcrop of Hamilton limestones of seventy feet. They are of medium hardness, light ash color. They make a beautiful trimming combined with red brick. We were unable to find a trace of organic existence in the rocks at this place.

The extreme upper Hamilton, east side of Shellrock River, at Rockford, may be the equivalent of the above. They are also destitute of fossils. They agree in lithology, except the latter are stained with the oxide of iron. They are known to be the western representatives of the upper Hamilton, because the Lime Creek fossiliferous beds repose upon them, which Prof. H. S. Williams has proved to be the equivalent of the base of the New York Chemung.

This unfossiliferous upper member of the Hamilton in Iowa seems to be the equivalent of the New York Genesee slate, and our lower argillaceous member the equivalent of the Marcellus shale.

Excavations for the plant of the tile works at Buffalo revealed a soft, argillaceous stratum, in which the *Ambocælia umbonata*, Conrad, are very numerous. This fossil, in Livingston County, New York, occurs in a similar stratum just below the Genesee slate.

It appears more than probable that the fault which is so unmistakably revealed at Valley City, in Scott County, between the Silurian and Devonian, may be continued through the whole line of strike of the two formations to the northern boundary of the State. No junction of these formations has thus far been seen or described. We have already seen that the Niagara rocks dip west and south. We also have the evidence that the Devonian dips west and south. Independence, Iowa, elevation 923 feet, is Hamilton; Waterloo, twenty-one miles west, elevation 1,046 feet, is Corniferous. Prof. Hall described the *Rensseleria johanni* from this place, and refers it to the Upper Helderberg. At Davenport and vicinity, the dip is south and west. There are numerous light folds in the Devonian strata, which have been planed down by erosion, so that the maximum thickness of many of its members cannot be determined.

FOSSILS OF THE HAMILTON GROUP COLLECTED IN SCOTT
COUNTY, IOWA, AND ROCK ISLAND COUNTY, ILLINOIS.

- ALVEOLITES, goldfussi, Billings...H.
subramus, Rominger...H.
AMBOCELIA, umbonata, Hall...H.
AMPLEXUS, new species...
ANCHYROCRINUS, new species...
ATHYRIS, angelica, Hall...Chem.
polita, Hall...Chem.
vittata, Hall...H.
ATRYPA, aspera schlotheum...H.
hystrix, Hall...Chem.
reticularis, Linnaeus...H.
AUOPORA, conferta, Winchell...H.
erecta, Rominger...H.
iowensis, Hall...Chem.
saxivadum, Hall...Chem.
serpens, Goldfuss...H.
AVICULA, two undetermined species.
AVICULOPECTEN, parilis, Conrad, Cor.
princeps, Conrad...H.
pecteniformis, Conrad...Mar. Shale.
unioensis, Worthen...Cor.
BELLEROPHON, undetermined species.
BLOTHYPHYLLUM, decorticatum,
Billings...Cor.
CALCEOOCRINUS, clarus, Hall...H.
species undetermined...
CARDIOPSIS, robusta, Hall...Port.
CENTRONELLA, impressa, Hall...H.
julia, Winchell...Marsh.
ovata, Hall...Cor.
CHÆTETES, many undetermined sp.
CHONETES, spucilla, Hall...H.
setigera, Hall...H.
undetermined species...
CHONOPHYLLUM, ponderosum, Ro-
minger...H.
CLADOPORA, fisheri, Billings...H.
canadensis, Rominger...H.
romeri, Billings...H.
lichenoides, Rominger...Cor.
CLEIDOPHORUS, oblongus, Hall...H.
CLOSTEROCRINUS, three undeter-
mined species...
CRANIA, bordendi, Hall...H.
crenistriata, Hall...H.
hamiltonensis, Hall...H.
5 CRINOIDS, genera undetermined.
CRYPTONELLA, planirostra, Hall...H.
eudora, Hall...Chem.
rectorostra, Hall...H.
CYATHOPHYLLUM, davidsoni, Hall...H.
geniculatum, Rominger...H.
rugosum, Edw. and Haime...Cor.
scyphus, Rominger...H.
CYSTIPHYLLUM, americanum, Edw.
and Haime...H.
CYSTIPHYLLUM, sulcatum, Bill...Cor.
two undetermined species...
CYRTINA, acutirostris, Shumard...H.
Chem.
curvilineata, White...H.
rectirostra, Hall...H.
triquetra, Hall...H.
umbonata, Hall...H.
three new species, two punctate.
DENDROPORA, ornata, Rominger...H.
DICTYOSTOMA, species undetermined.
DIPHYPHYLLUM, archiaci, Billings...H.
rectiseptatum, Rominger...H.
simcoense, Billings...Cor.
DISCINA, doria, Hall...H.
humulis, Hall...Mar. Shale.
lodiensis, Vanuxem...Gen. Slate.
media, Hall...Chem.
newberryi, Hall...Chem.
seneca, Hall...H.
truncata, Hall...Chem.
ELÆACRINUS, lucina, Hall...H.
meloniformis, Barris...H.
new species...
EUOMPHALUS, cyclostoma, Hall...H.
FAVOSITES, hamiltonensis, Rom...H.
limitaris, Rominger...Cor.
nitellus, Winchell...H.
radiformis, Rominger...H.
FENISTELLA, many undetermined sp.
FISTULIPORA, undetermined species.
Genera undetermined...
GOMPHOCERAS, ajax, Hall...Port.
lunatum, Hall...H.
solidum, Hall...Mar. Shale.
GONIOPORA, species undetermined.
GYROCERAS, transversum, Hall...H.
LEIORHYNCHUS, alta, Calvin (Solon)
Pentamerus, alta, Calvin...
LEIORHYNCHUS, iris, Hall...Chem.
kelloggi, Hall...Chem.
multicosta, Hall...H.
mysia, Hall...Mar. Shale.
LEPERDITIA, spinulifera, Hall...Cor.
LICHENALIA, species undetermined.
LINGULA, exilis, Hall...Mar. Shale.
legea, Hall...H.
punctata, Hall...H.
nuda, Hall...H.
MEGISTOCRINUS, latus, Hall...H.
MERISTELLA, doris, Hall...Cor.
haskensi, Hall...H.
lenta, Hall...Oris.
meta, Hall...H.
rostrata, Hall...H.
MELOCRINUS, new species...

- MONTICULIPORA, monticula, White, H.
many undetermined species..... H.
- MURCHISONIA, micula, Hall..... H.
species undetermined..... H.
- NUCLEOSPIRA, concinna, Hall..... H.
- ORTHIS, cyclos, Hall..... H.
iowensis, Hall..... H.
propinqua, Hall..... Cor.
suborbicularis, Hall..... H.
tioga, Hall..... Port.
tulliensis, Vanuxem..... Tully.
vanuxemi, Hall..... H.
hibrida, ? Sowerby..... L. Helder.
livia, Billings..... Cor.
- ORTHOCERAS, jaculum, Hall..... Cor.
- PARACYCLAS, ellipticus, var. occi-
dentalis, Hall..... Cor.
lirata, Conrad..... Cor.
ohioensis, Meek..... Cor.
two undetermined species..... H.
- PENTAMERUS, comis, Owen..... H.
- PENTAMERELLA, arata, Conrad..... Cor.
dubia, Hall..... H.
- PHACOPS, bufo, Green..... H.
- PHILIPASTREA, gigas, Owen..... Dev.
verneuili, Edw. and Haime..... H.
- PLATYCERAS, ammon, Hall..... Cor.
argo, Hall..... Cor.
auriculatum, Hall..... H.
conicum, Hall..... H.
bucculentum, Hall..... H.
fornicatum, Hall..... Cor.
carinatum, Hall..... H.
cymbum, Hall..... Cor.
erectum, Hall..... H.
rictum, Hall..... H.
symmetricum, Hall..... H.
tethis, Hall..... H.
tethis, var. subspinosum, Hall..... H.
ventricosum, Conrad..... L. Helder.
- PLATYCRINUS, species undetermined.
- PROETUS, angustifrons, Hall..... Scho. Grit.
macrocephalus, Hall..... H.
marginalis, Conrad..... Tully.
occidens, Hall..... H.
prouti, Shumard..... H.
Synonym, *davenportensis*, Barris.
rowi, Green..... H.
- ACTINOPTERIA, decusita, Hall..... H.
Synonym, *Avicula cancellata*,
Barris.....
- PLEUROTOMARIA, lucina, var. per-
fasciata, Hall..... H.
trilix, Hall..... H.
- PRODUCTELLA, exanthemus, Hall..... H.
hystricula, Hall..... Chem.
navicella, Hall..... H.
spinulicosta, Hall..... H.
subalatus, Hall..... H.
- PTERINEA, flabellum, Conrad..... H.
subpapyracea, Meek and Worthen, H.
undetermined species..... H.
- PTILODYCTIA, two undetermined sp.
- PTYCTODUS, calceolus, Newberry
and Worthen..... H.
- RHYNCHOSPIRA, subglobosa, Hall,
Scho. Grit.
- SCHAPHOCRINUS, new species.....
- SPIRIFERA, aspera, Hall..... H.
cedarensis, Owen..... H.
duodenaria, Hall..... Cor.
engelmani, Meek..... Oris.
euruteinis, Owen..... Cor.
euruteinis, var. fornacula, Hall..... H.
fimbriata, Conrad..... Oris.
formosa, Hall..... H.
macrea, Hall..... Cor.
manni, Hall..... Cor.
mesastrialis, Hall..... Chem. and Cor.
mucronata, Conrad..... H.
paradoxus, Schlotheum..... Cor.
parryana, Hall..... H.
hemicyclus, Meek and Worthen, Oris.
pinnata, Owen..... H.
perextensus, Meek and Worthen,
Onon.
rariocosta, Conrad..... Cor.
sculptilis, Hall..... H.
subattenuata, Hall..... H.
subumbonata, Hall..... H.
tribulis, Hall..... Oris.
tullia, Hall..... H.
varicosa, Hall..... H.
ziczac, Hall..... H.
three undetermined species.....
- STREPTORHYNCHUS, chemungensis,
Conrad..... Chem.
perversus, Hall..... H.
two new species.....
- STREPTELASMA, rectum, Hall..... H.
many undetermined species.....
- STROMBODES, alpenensis, Rominger, H.
- STRIATOPORA, iowensis, Owen..... H.
- STROMATOPORA, concentrica, Gold-
fuss..... Ni.
eratica, Hall..... Chem.
nodulata, Nicholson..... Cor.
substriatella, Nicholson..... Cor.
- STOMATOPORA, alternata, Hall, Chem.
incrusters, Hall..... Chem.
- STENOSCHISMA, contractum, Hall,
Chem.
exemium, Hall..... Chem.
royanum, Hall..... Cor.
stevani, Hall..... Chem.
- STICTOPORA, species undetermined.
- STROPHODONTA, callosa, Hall,
Scho. Grit.
demissa, Conrad..... Chem.

STROPHODONTA, inaequiradiata, Hall, Cor.	TAXOCRINUS, gracilis, M. and W., H. interscapularis, Hall.....H.
inaequistriata, Conrad.....H.	nunitus, Hall.....H.
mucronata, Conrad.....Chem.	species undetermined.....
macra, Hall.....H.	TROCHONEMA, species undetermined.
parva, Owen.....H.	TEREBRATULA, harmoni, Hall...Cor.
perplana, Conrad.....H.	julia, Hall.....Cor.
variastrata, Hall.....L. Helder.	lens, Hall.....Cor.
plicata, Hall.....H.	linclæni, Hall.....H.
undetermined species.....	navicella, Hall.....H.
SPONGIA, two undetermined species.	romingeri, Hall.....H.
SYNBATHOCRINUS, matutinus, Hall, H.	sulivanti, Hall.....H.
SYRINGOPORA, nobilis, Billings...Cor.	two undetermined species.....
TENTACULITES, belulus, Hall....H.	ZAPHRENTES, exigua, Billings...Cor.
TREMATOSPIRA, gibbosa, Hall....H.	ungula, Rominger...Cor.
TROCHOCERAS, new species.....	

RECAPITULATION.—Of the 260 species collected in the two counties named above, there have been described from the following groups, to-wit: Niagara, 1; Lower Helderberg, 3; Onondaga, 1; Oriskany, 5; Schoharie Grit, 3; Corniferous, 37; Marcellus Shale, 5; Hamilton, 120; Tully, 11; Portage, 3; Marshall, 1; Chemung, 22; Genesee Slate, 1; new and undetermined species, 46.

The literature on Devonian corals is yet too limited to enable the student to classify many of the corals collected in the Devonian strata of this vicinity, leaving many species of *Cyathophyllum*, *Streptelasma*, *Zaphrentes*, *Favosites*, *Monticulipora*, *Fenistella*, *Chaetetes*, and *Stromatopora*, without specific identification.*

Of the above Hamilton fossils, fifty-five have been described in horizons below the Hamilton and thirty-eight of them in horizons above.

* We sent to Prof. William J. Davis, Louisville, at his request, in 1881, about fifty pounds of corals, with the request for him to return one specimen where there were duplicates. A few we marked "Please return," and requested fossils in exchange for others. He acknowledged the receipt by card, since which time we have not heard from him; nor does he answer our communications.

CHEMUNG(?).

At the upper end of Andalusia, in a ravine and above the road, there is an outlier of a formation quite distinct from any other in the two counties. Just above the road we collected the *Orthis impressa*, Hall, Chemung. These were associated with Hamilton fossils. About forty rods further up the same ravine may be found the formation referred to above. A quarry was being worked there in a hard, calcareous limestone, the strata ranging from six to ten inches in thickness. The following fossils were collected there, all closely associated: *Aclis*; *Ambocælia*?; *Bellerophon bowmani*, White; *Cyclonema concinum*, Hall, Chemung; *Fistulipora*; *Pleurotomaria*, two species; *Proetus missouriensis*, Shumard, Chemung; *Loxonema*; *Strophodonta cayuta*, Hall, Chemung; *Strophodonta plicata*, Hall, Hamilton. The *B. bowmani* is closely allied to *B. marcuianus* of the coal-measures. The *Pleurotomarias* are closely allied to coal-measure forms. Small Crinoid joints are quite numerous in the rock, some of which are pentagonal.

Prof. Hall, in his "Geology of Iowa" (pp. 88-91), has described the "gray-yellow sandstones" at Burlington, Iowa, as the equivalent of the New York Chemung group. He has included the Oölite limestones at the base of the Burlington limestones with the Chemung.

Prof. Worthen has included the Oölite limestones with the underlying siliceous shales, and applied the name "Kinderhook group" (Geol. Illinois, Vol. I., p. 108). Prof. White includes the Oölite with the beds below, and assigns them to the sub-Carboniferous, with Messrs. Meek and Worthen (Geol. Iowa, Vol. I., p. 192).

If we draw the line of separation between the Devonian and sub-Carboniferous below the Oölitic formation, we may see that the beds below have lost their Carboniferous character, and that they have many fossils representing the Devonian formation.

The Oölitic band is not persistent at Burlington.

At the north end of Main street the Burlington limestone may be seen resting on the yellow sandstone, no Oölite between them. There are thin bands of Oölite interstratified in the Burlington, one of one inch and one of one-half inch, with strata of Burlington limestone and Crinoid joints below. On Division street, between Sev-

enth and Eighth streets, some sixteen feet of the yellow sandstone are exposed, a thin band of Burlington limestone on the top, no Oölite present. The top of the sandstone is hard. Eight feet below a stratum of soft sandstone is filled with *Spirifera mucronata*, below which there are several hard, calcareous strata filled with Chonetes. On south Third street, and adjacent to the quarry, the outcrop of the sand-rock is soft, and is filled to repletion with *Spirifera* of several species, *S. mucronata* being the most numerous. This is not more than six feet below the Oölite, which in their fossil contents seem to be Devonian and beds of passage from the Devonian to the sub-Carboniferous.

We have sent specimens collected at two different times to Prof. Henry S. Williams, of Cornell College, who takes the same view as the writer—that these beds are Devonian. The writer regards them as the equivalent of the base of the New York Chemung, the higher beds not having been deposited in the West.

The experience of the writer has taught him that the fauna of the Palæozoic rocks began their life far below where they are abundant and terminated it far above. Prof. E. W. Claypole recognizes "an intermediate *Catskill Chemung* group" (Geol. Penn., G. 7, p. 54 G.), which attains a thickness of one thousand and seven feet (p. 240 G.), and Chemung fossils reaching far above in the Catskill group.

We have made no mention of the fish-teeth collected in the yellow sandstone at Burlington, for the reason that they have not, thus far, been collected and described in the New York Chemung. They are interstratified with the Hamilton and Chemung fossils at Burlington. The Kinderhook group in Marshall County and the Devonian forms are represented in about the same proportion. The fish-teeth are the only fossils in the highest beds.

FOSSILS COLLECTED AT BURLINGTON, IOWA, FROM THE YELLOW SANDSTONE.

BELIEVED TO BE THE EQUIVALENT OF THE BASE OF THE NEW YORK CHEMUNG.

ACTINOPTERA, epsilon, Hall. Chem.	CHONETES, carinata, Conrad. H.
ATHYRAS, polita, Hall. Chem.	fisheri, Norwood and P. Chem.
ATRYPA, aspera, Hall. Chem.	illinoisensis, Worthen. Ches.
reticularis, Linnæus. Dev.	ornata, Shumard. Chem.
BELLEROPHON, lyra, Hall. H.	logani, Norwood and P. Chem.
striatus, Sowerby. Port.	pucilla, Hall. H.
CONULARIA, continens, Hall.	mucronata, Hall. Chem.
Mar. Shale.	scitula, Hall. H.
CYPRICARDITES, contractus, Hall,	setigera, Hall. Chem.
Old Red Sandstone.	yandelliana, Hall. Cor.
species undetermined.	COLEOLUS, aciculum, Hall. Port.

DOXIOBIA, subrhomboidea, Hall, Chem. ovata, Hall. Chem.	PALÆONEILO, bedfordensis, Meek, Waverly.
EUOMPHALUS, obtusus, Hall. Oölite. EDMONDIA, species undetermined.	brevis, Hall. Chem.
GRAMMYSIA, hannibalensis, Shu., Ches.	PINNA, species undetermined.
LEIORHYNCHUS, kelloggi, Hall, Chem. multicosta, Hall. H.	PLACUNOPSIS, new species.
LIMOPTERA, cancellata, Hall and Whitfield. U. Helder.	PTERINEA, chemungensis, Con., Chem.
LEPTODESMA, socialis, Hall. Chem. marcellence, Hall. Mar. Shale.	PTERINOPECTEN, suborbicularis, Hall. Chem.
LUCINA, retrusa, Hall. Port.	PLATYCERAS, carinatum, Hall. Cor.
MYALINA, michiganensis, Win., Mar.	RHYNCHONELLA, cooperensis, Shumard. Chem.
NUCULA, lineolata, Hall. Port.	missouriensis, Shumard. Chem.
hians, Hall. H.	SANGUINOLITES, ridgidum, White and Whitfield. K.
three undetermined species.	SPIRIFERA, alta, Hall. Chem.
ORTHIS, leionensis, Hall. Chem.	disjuncta, Sowerby. Chem.
solitaria, Hall. H.	duodenaria, Hall. Cor.
tenuistriata, Hall. Port.	biplicata, Hall. Chem.
tulliensis, Vanuxem. Tully.	fimbriata, Conrad. Cor.
ORTHONOTA, undulata?, Conrad. H.	lineata, Martin. Coal-meas.
ORTHOCERAS, hectocinctum, Win., K.	marionensis, Shumard. H.
whitei, Winchell. K.	mesocostalis, Hall. Chem.
PRODUCTUS, flemingi, var. burling- tonensis, Hall. Bur.	medialis, Hall. H.
arcuatus, Hall. Chem.	mucronata, Conrad. H.
subhoridus.	peculiaris, Shumard. Chem.
PRODUCTELLA, arctirostrata, Hall, Chem.	strigosus, Meek. Dev.
concentrica, Hall. Chem.	subrotundatis, Hall. Chem.
hirsuta, Hall. Chem.	subumbonata, Hall. Chem.
hirsuta, var. rectispina, Hall. Chem.	STENOSCHISMA, contracta, Hall. H.
lachrymosa, var. stigmata, Hall, Chem.	prolificum, Hall. H.
lachrymosa, Conrad. Chem.	sappho, Hall. H.
shumardiana, Hall. Chem.	stevani, Hall. Chem.
spinulicosta, Hall. Chem.	STREPTORHYNCHUS, chemungensis, Conrad. Chem.
spinosa, Hall. Chem.	perversa, Hall. H.
PTERINOPECTEN, suborbicularis, Hall. Chem.	STROPHODONTA, cayuta, Hall, Chem.
	demissa, Conrad. H.
	SYRINGOTHYRAS, halli, Winchell, L. Car.

RECAPITULATION.—Of the above list of 84 species of fossils collected from the yellow sandstone at Burlington, Iowa, 32 have been described from horizons below the Chemung, 41 from the Chemung, 7 from horizons the equivalent of the Chemung, and only 4 from horizons above the Chemung.

FOSSILS COLLECTED IN THE OOLITE BAND AT BURLINGTON, IOWA.

CHONETES, logani, var. aurora, N. and P. Tully.	LIMA, retifera, Shumard. Coal-meas.
setigera, Hall. Chem.	ORTHIS, lenticularis, Hall. Chem.
lepida, Hall. H.	leionensis, Hall. Chem.
mucronata, Hall. H.	micellini, L'Eville. L. Car.
ENTHOLIUM, circulus, Shumard, Oölite and Coal-meas.	solitaria, Hall. H.
EUOMPHALUS, obtusus, Hall. Oölite.	vanuxemi, Hall. H.
new species.	ORTHOCERAS, two undetermined sp.
	PRODUCTELLA, arctorostrata, Hall, Chem.

SPIRIFERA, bicipitata, Hall.	Oölite.	STREPTORHYNCHUS, arctorostrata,	
bimesialis, Hall.	Oölite.	Hall.	Chem.
inutilus, Hall.	H.	chemungensis, Conrad.	Chem.
ziczac, Hall.	H.	chemungensis, var. pandora, Bil-	
STENOSCHISMA, prolificum, Hall.	H.	lings.	Cor.

RECAPITULATION.— The above 21 species of fossils from the Oölite still retain a preponderance of Devonian forms.

COAL-MEASURE DEPOSITS.

The Coal-measures have been deposited in the counties of Scott, Rock Island, and Muscatine unconformably on many different members of the Silurian and Devonian formations.

It is highly probable that the largest portion of the six hundred feet of Coal-measures known in Iowa was once deposited at this place. There has been ample time for them to have been eroded out. Since the close of the Coal-measure period, the Colorado River has abraded its cañon six thousand feet deep, through rocks of all ages, from the barren Coal-measures to the granite, with less than half of the rain-fall of the Mississippi valley. (See Powell's "Cañon of the Colorado.") This appears evident from the fact that the Devonian rocks have been degraded but a few feet in depth since the Coal-measures were deposited at this place.

There are numerous remnants of conglomerate sand-rock and coal shales in place adjacent to the Mississippi River, and but little elevated above its waters, from near Le Claire to the western extremities of the above counties.

The Wapsipinecon and Cedar Rivers have cut out the Coal-measures and all its outliers throughout their whole system of drainage.

The outliers in Scott and Muscatine Counties have their drainage directly to the Mississippi River. The Iowa River has left a few unimportant outliers on its flanks.

At Rapids City, high on the slope of the bluff, there are several very large, angular blocks of conglomerate sand-rock, which have been transported from the north at a time so remote that the ice and water of the river left them where we now find them. There are some engravings on them pertaining to the Christian faith,

which were doubtless made by the Catholic missionaries who first explored this valley. Small pieces of this sand-rock and coal are quite common in the boulder clay in Rock Island County.

FAULTS.

The lower or principal fault at Valley City extends west below the mouth of Crow Creek, crossing the Mississippi River, and reaching the Illinois shore about two miles west of Hampton, having a width of more than two miles. The Hampton, Cleveland, and Green River coal-banks are worked in the line of its strike. These coals have been of good quality, having a thickness of four feet, and having a good roof. They have been, for the most part, worked out. This fault separates the Silurian and Devonian formations.

At Valley City Mr. Spencer, boring for water, passed through two feet of coal at a depth of eighty feet. Mr. Garrett Donaldson opened coal in the line of this fault, but found it unremunerative, as all the explorations between Davenport and Le Claire have been, and are likely to be in the future.

The upper fault is in the Niagara limestone. It crosses the river above Smith's Island to Rapids City, at which place, at Williams' bank, the coal is six feet thick. It is less at Gilchrist's mine. There are four mines in the line of strike of this fault in the north of Henry County and south of Rock River. Two of these are seven miles north and a little east of Geneseo, and one mile apart. At the mine the farthest east the coal is five feet thick, with six inches of shale dividing the upper two feet from the coal below. At the west mine the shale increases to a thickness of eight feet. It is possible that this fault continues south-east and connects with the great subsidence at La Salle.

Between Cleveland and Carbon Cliff the conglomerate sand-rock crops out at a higher altitude than the coal occupies at either place. It is a light gray friable sand-rock, easy to work. It seems to be lacking cement to hold the grains of sand together. Rock River, from this place to its confluence with the Mississippi, has abraded its channel through Coal-measures, leaving numerous outliers of coal and sand-rock on either side. Messrs. Park & Hiller have opened a bank on Section 24, Coal Valley Township, by drifting into the bluff where a small stream had cut through some six feet of hard limestone and eight feet of flint. This is the heaviest de-

velopment of flint known to overlie No. 1 coal. It is quite common to find one foot of flint a few feet above the coal. In many cases there is none.

At Blackhawk's Watch-tower, on the north side of Rock River, the conglomerate sand-rock rises abruptly to a height of eighty feet. A short distance north there is a ravine forty feet lower. Here the Hon. Bailey Davenport has opened coal. At a depth of ten feet there are two feet of very pure coal, with clay shales above and below. Forty feet below this there are four feet of coal. When this is well assorted it is of good quality. These shales are all filled with impressions of the ancient coal flora, no marine fauna having been found in any of them.

Half a mile south-east of the watch-tower the coal and under clay are in the bed of the river. Between these places the Corniferous lime-rock juts up on the shore. On the slope between the watch-tower sand-rock and the river there is a slide that once contained considerable coal, which has long since been worked out, and many fruitless endeavors have been made to find coal under the sand-rock. This conglomerate sand-rock is believed to be below the lowest coal in all countries. It is the "mill-stone grit" of English geologists. There are numerous azoic water-worn pebbles, well rounded by attrition, in the base of this sand-rock. In a ravine a short distance from this place the rock is, for the most part, composed of water-worn pebbles of sand-rock much like the paste which cements them.

From Milan to Andalusia the coal is thin and impure.

Below Andalusia the sand-rocks extend high up in the bluff, above which there is a seam of impure coal. Mr. Boney, in 1874, opened coal in a slide on the bottom below Andalusia, with the expectation that the coal extended under the sand-rock of the bluff. He soon found out his mistake and abandoned the enterprise.

In Buffalo Township, Scott County, coal has been opened in Sections 2, 3, 4, 5, 6, 9, 10, and 11. The coal varies in thickness in the same opening from two to four feet. Some of these mines have been worked for thirty years, and have furnished an abundant supply of excellent coal for local use; and they give promise of furnishing a local supply for a long time to come.

The clay shales below the lower coal are exposed in Blackhawk Creek at Blackhawk, Scott County. There is a fair probability of a paying vein of coal near the head of this creek.

In Section 7, Rockingham Township, the coal is split into two parts. It is said to be split into three parts on the bottoms in this township. The lower sand-rocks crop out on Section 8 at a higher altitude. There is abundant evidence that the Devonian rocks were deeply scored and grooved by the lateral drainage anterior to the deposition of the coal period.

The lower vein, No. 1, is the only coal remaining in Scott County or the north half of Rock Island County. It is not persistent over large areas, as the higher middle members are, it having been deposited in small basins, with ragged, irregular contour, in the eroded impress of the underlying rocks.

The shales of No. 2 coal outcrop with considerable force on Copperas Creek, Section 30, Edgington Township, Rock Island County. Very fine specimens of *Anularia inflata*, Lesgereux, were collected at this place. These shales are soft arenaceous, and split in thin folia. They are reached, in digging wells on the high prairie, at a depth of thirty feet.

The writer bored for coal on the east half of the south-west quarter of Section 20, Edgington Township, to a depth of fifty feet in the boulder clay, commencing thirty feet below the top at that formation. No other formation was reached. The boring was commenced below the levels of the No. 2 shales, thus showing that this heavy development of boulder clay was deposited in an eroded basin, the shales on the table prairie being covered with *Loess*.

The Coal Valley Mining Company having exhausted their supply at Coal Valley, Mr. Cable transferred his mining interest to Mercer County, on the Edwards River, where coal No. 2 is well developed. It is the equivalent of the lower vein at La Salle. Its average quality is superior to any other member of the Illinois coal-veins. The mining village is called Cable. Rock Island and Davenport are largely supplied from these mines.

Farther down the Edwards River, in Sections 28 and 29, Township 15, Range 2 west, several mines have been worked in No. 2 coal. The coal has a thickness of three feet or more, a roof of two to three feet of impure limestone, above which there are sixteen feet of soft, fine-grained sand-rock, which has been mistaken for limestone. It does not effervesce with acids. The silica is so fine it can be sawn with a wood-saw and planed with a plane. It hardens by exposure, and is a valuable building-stone. The coal has a hard, smooth floor, apparently slate, and no under clay.

The sand shales of No. 2 coal crop out on Mud Creek, in Atkinson Township, Henry County, on Section 7, Township 16, Range 5 east. No explorations for the coal have been made at that place. No. 3 coal has been opened at six different places in Atkinson Township, two places in Cornwall Township, and two places at Cambridge. It is connected with the great Illinois coal deposits south and east. It ranges from thirty to thirty-six inches in thickness, having a slate roof and fire-clay below. No. 2 coal at the Atkinson mines is only about one foot in thickness, and thirty-five feet below No. 3. It is not known whether or not No. 1 coal is developed at this place.

APPENDIX.

The following are the numbers of species in our collection classified at the present time, in addition to the foregoing lists:

Potsdam, 2 species; Calciferous, 3; New York, Trenton, and Utica Slate, 97; Minnesota Trenton, 33; New York Lower Helderberg, 89; Clinton group, Rochester, 27; New York Niagara, 36; Ohio and Indiana Niagara, 28; Bridgeport, Illinois, Niagara, 109; New York Corniferous, 112; New York Marcellus Shale, 43; New York Hamilton, 237; New York Chemung, 38; Rockford, Iowa, Chemung, 92; Le Grand, Iowa, Kinderhook (Chemung), 83; Burlington, Iowa, beds, 148; 70 species of Crinoids, besides a large collection not yet classified; Keokuk group, 130; Chester beds, 31; St. Louis beds, Spurgeon Hill, Indiana, 76, 15 of which are undetermined species; Coal-measures, 237; Silurian from Bohemia, 26; Cretaceous forms, United States, 34; Eocene, 6; Miocene, 10; Pliocene, 2. From Europe: Lias and Trias, 26; Cretaceous, 9; Eocene, 4; Miocene, 43; and Pliocene, 1.



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